REMARKS

Claims 1-15, 17-25, 30-34 and 37-42 are all the claims presently pending in the application. By this Amendment, claim 16 has been canceled, claims 41-42 have been added, and claims 1, 2-10, 12, 14-15, 17, 19-21, 31-34 and 37-40 have been amended. Claims 2-7, 9-11, 14-15, 17-25 and 31-34 have been withdrawn from prosecution as allegedly directed to a non-elected species.

It is noted that the claim amendments are made only for more particularly pointing out the invention, and not for distinguishing the invention over the prior art, narrowing the claims or for any statutory requirements of patentability. Further, Applicant specifically states that no amendment to any claim herein should be construed as a disclaimer of any interest in or right to an equivalent of any element or feature of the amended claim.

Claims 1, 8, 37-38 and 40 stand rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Daughton (U. S. Patent No. 6,744,086) in view of Chen et al. (U.S. Patent No. 5,917,749). Claims 12 and 39 stand rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Daughton and Chen and further in view of Nakada et al. (U.S. Patent No. 6,341,053).

These rejections are respectfully traversed in view of the following discussion.

I. THE CLAIMED INVENTION

Applicant notes that the features of the exemplary aspects of the claimed invention which are described in this Amendment may pertain only to those particular aspects of the claimed invention. These features are not necessarily included in other aspects of the invention and, therefore, the description of such features in this Amendment should in no way be considered as limiting other aspects of the invention which may be disclosed in the present Application or which may be the subject of other patents or patent applications.

The claimed invention, as exemplarily described by independent claim 1, is directed to a spin-current switched magnetic memory element, including a plurality of magnetic layers, including a fixed magnetic layer having a fixed magnetic moment, and a free magnetic layer having a magnetic moment which is switchable by a spin-current, and a barrier layer formed between said fixed and free magnetic layers.

Importantly, the plurality of magnetic layers includes a perpendicular magnetic anisotropy component, H_p, with a magnitude sufficient to at least substantially offset an easy-

plane demagnetization effect $4\pi M_s$, where M_s is a saturation magnetization, such that the perpendicular magnetic anisotropy component, H_p, reduces an amount of spin current needed to rotate the magnetic moment of the free magnetic layer out of the film plane (Application at [0069]).

In conventional magnetic memory elements, the threshold current is too high (e.g., by at least an order of magnitude) for successful insertion into current generation complementary metal oxide semiconductor (CMOS) circuits (Application at page 2, lines 5-8).

In the claimed invention, on the other hand, the plurality of magnetic layers includes a perpendicular magnetic anisotropy component, H_p, with a magnitude sufficient to at least substantially offset an easy-plane demagnetization effect $4\pi M_s$, where M_s is a saturation magnetization, such that the perpendicular magnetic anisotropy component, H_p, reduces an amount of spin current needed to rotate the magnetic moment of the free magnetic layer out of the film plane (Application at [0069]). That is, unlike other memory elements (e.g., magnetic-field-based memory elements), the claimed invention may utilize the perpendicular magnetic anisotropy component observed in some magnetic thin films to at least substantially offset (e.g., counter-balance) the strong demagnetization effect $4\pi M_s$, thus removing the main barrier for current induced magnetic reversal, and reduce the switching current threshold (Application at page 9, line 22-page 10, line 4).

II. THE ALLEGED PRIOR ART REFERENCES

A. Daughton and Chen

The Examiner alleges that Daughton would have been combined with Chen to form the invention of claims 1, 8, 37-38 and 40. Applicant submits, however, that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention.

Applicant respectfully submits that these references are unrelated and would not have been combined as alleged by the Examiner. Thus, no person of ordinary skill in the art would have considered combining these disparate references, absent impermissible hindsight.

Further, Applicant submits that there is no motivation or suggestion in the references to urge the combination as alleged by the Examiner. Indeed, these references clearly do not teach or suggest their combination. Therefore, Applicant respectfully submits that one of ordinary skill in the art would not have been so motivated to combine the references as alleged by the

Examiner. Therefore, the Examiner has failed to make a prima facie case of obviousness.

In fact, generally speaking, all cited prior art (except Daughton) teachings were directed at conventional magnetic random access memory elements using a magnetic field generated by electric current for writing. That is a fundamentally different physical process, and bears no resemblance to the claimed invention (e.g., a spin-torque-driven writing process). In particular, an exemplary aspect of the claimed invention addresses physical processes, devices structures, and operating principles entirely different from those in the teachings and claims of Daughton, Chen and other cited prior art patents. Knowing what they disclosed and their combination would not arrive at the claimed invention which may address a specific problem (e.g., excess write-current density requirement) of a new class of memory element (e.g., a spin-torque-driven memory element) unrelated to the prior art.

Moreover, Applicant respectfully submits that neither Daughton, nor Chen, nor any alleged combination thereof teaches or suggests "*wherein said plurality of magnetic layers includes a perpendicular magnetic anisotropy component, H_p, with a magnitude sufficient to at least substantially offset an easy-plane demagnetization effect $4\pi M_s$, where M_s is a saturation magnetization, such that said perpendicular magnetic anisotropy component, H_p, reduces an amount of spin current needed to rotate said magnetic moment of said free magnetic layer out of the film plane*", as recited, for example, in claim 1. That is, unlike other memory elements (e.g., magnetic-field-based memory elements), the claimed invention may utilize the perpendicular magnetic anisotropy component observed in some magnetic thin films to at least substantially offset (e.g., counter-balance) the strong demagnetization effect $4\pi M_s$, thus removing the main barrier for current induced magnetic reversal, and reduce the switching current threshold (Application at page 9, line 22-page 10, line 4).

Clearly, this feature is not taught or suggested by Daughton.

Indeed, Daughton simply teaches a structure including a free layer 4 and a fixed layer 6 (Daughton at col. 4, lines 21-37; Figure 1A). However, nowhere does Daughton teach or suggest anything about the benefit of a perpendicular magnetic anisotropy component in a plurality of magnetic layers including the free and fixed layers 4, 6 that would reduce the switching current density of a spin-torque-based switch. Thus, Daughton certainly does not teach or suggest a plurality of magnetic layers which includes a perpendicular magnetic anisotropy component, H_p, with a magnitude sufficient to at least substantially offset an easy-plane demagnetization effect $4\pi M_s$, where M_s is a saturation magnetization, such that the perpendicular magnetic anisotropy

component, H_p, reduces an amount of spin current needed to rotate the magnetic moment of the free magnetic layer out of the film plane (Application at [0069]).

Indeed, the Examiner expressly concedes that Daughton does not teach or suggest "at least one of said plurality of magnetic layers having a perpendicular magnetic anisotropy component", on page 3 of the Office Action.

The Examiner then alleges that Chen makes up for this deficiency in Daughton, but the Examiner is incorrect. In fact, Applicant would again point out that Chen's device is structurally very different from the claimed invention (e.g., claim 1), in that Chen does not teach or suggest a spin current. Instead, Chen teaches simply that the current flows near or passes by one of the magnetic layers only to generate a magnetic field. Chen's current for switching operation does not pass through the "stack" containing the magnetic tunnel junction. That is, Chen does not teach or suggest a **spin-current switchable** magnetic moment, nor does Chen teach or suggest the benefit of perpendicular anisotropy component to spin-current switchable devices in reducing switching current. Such benefit is non-obvious to even the experts due to different operating principles of these two different classes of magnetic memory devices -- conventional, field-driven magnetic memory elements and the spin-torque-driven magnetic memory elements. Furthermore, since Chen's teaching is unrelated to spin-torque memory, his materials selection and combination is not suitable for reduction of spin-torque switching current. Thus, on all these levels from device structure design to operating principle, Chen's disclosure is irrelevant and would not lead to the claimed invention.

Moreover, Chen simply teaches setting an easy axis of magnetic anisotropy approximately perpendicular to the easy axis of the shape anisotropy (Chen at col. 3, lines 13-33). This is different from the claimed invention which includes a plurality of magnetic layers including a perpendicular magnetic anisotropy component (e.g., a component of magnetic anisotropy which is perpendicular to a film plane in said plurality of magnetic layers).

Thus, nowhere does Chen teach or suggest a plurality of magnetic layers which includes a perpendicular magnetic anisotropy component, H_p, with a magnitude sufficient to at least substantially offset an easy-plane demagnetization effect $4\pi M_s$, where M_s is a saturation magnetization, such that the perpendicular magnetic anisotropy component, H_p, reduces an amount of spin current needed to rotate the magnetic moment of the free magnetic layer out of the film plane. Therefore, Chen clearly does not make up for the deficiencies of Daughton.

Therefore, Applicant again submits that these references would not have been combined

and even if combined, the combination would not teach or suggest each and every feature of the claimed invention. Therefore, the Examiner is respectfully requested to withdraw this rejection.

B. Nakada

The Examiner alleges that Daughton and Chen would have been further combined with Nakada to form the invention of claims 12 and 39. Applicant submits, however, that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention.

Nakada discloses a magnetic tunnel junction device which includes a stack of multi layers which include a pinning layer, free layer a tunneling barrier layer, a pinned layer and a second pinning layer (Nakada at Abstract).

Applicant respectfully submits that these references are unrelated and would not have been combined as alleged by the Examiner. Thus, no person of ordinary skill in the art would have considered combining these disparate references, absent impermissible hindsight.

Further, Applicant submits that there is no motivation or suggestion in the references to urge the combination as alleged by the Examiner. Indeed, these references clearly do not teach or suggest their combination. Therefore, Applicant respectfully submits that one of ordinary skill in the art would not have been so motivated to combine the references as alleged by the Examiner. Therefore, the Examiner has failed to make a prima facie case of obviousness.

Moreover, neither Daughton, nor Chen, nor Nakada, nor any combination thereof teaches or suggests "*wherein said plurality of magnetic layers includes a perpendicular magnetic anisotropy component, H_p, with a magnitude sufficient to at least substantially offset an easy-plane demagnetization effect $4\pi M_s$, where M_s is a saturation magnetization, such that said perpendicular magnetic anisotropy component, H_p, reduces an amount of spin current needed to rotate said magnetic moment of said free magnetic layer out of the film plane*", as recited, for example, in claim 1. That is, unlike other memory elements (e.g., magnetic-field-write-based memory elements), the claimed invention may utilize the perpendicular magnetic anisotropy component observed in some magnetic thin films to at least substantially offset (e.g., counter-balance) the strong demagnetization effect $4\pi M_s$, thus removing the main barrier for current induced magnetic reversal, and reduce the switching current threshold (Application at page 9, line 22-page 10, line 4).

Clearly, this feature is not taught or suggested in Nakada.

In fact, Nakada simply discloses a magnetic tunnel junction device including a ferromagnetic fee layer 15, a tunneling barrier 16, a pinned layer 17 and a pinning layer 18 (Nakada at Figure 1; col. 4, lines 41-54). Nowhere does Nakada teach or suggest a plurality of magnetic layers including a perpendicular magnetic anisotropy component (e.g., a component of magnetic anisotropy which is perpendicular to a film plane in said plurality of magnetic layers).

Thus, like Daughton and Chen, nowhere does Nakada teach or suggest a plurality of magnetic layers which includes a perpendicular magnetic anisotropy component, H_p, with a magnitude sufficient to at least substantially offset an easy-plane demagnetization effect $4\pi M_s$, where M_s is a saturation magnetization, such that the perpendicular magnetic anisotropy component, H_p, reduces an amount of spin current needed to rotate the magnetic moment of the free magnetic layer out of the film plane. Thus, Nakada clearly does not make up for the deficiencies in Daughton and Chen.

Therefore, Applicant submits that these references would not have been combined and even if combined, the combination would not teach or suggest each and every feature of the claimed invention. Therefore, the Examiner is respectfully requested to withdraw this rejection.

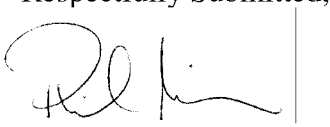
III. FORMAL MATTERS AND CONCLUSION

In view of the foregoing, Applicant submits that claims 1-15, 17-25, 30-34 and 37-42, all the claims presently pending in the application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview.

The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Assignee's Deposit Account No. 50-0510.

Respectfully Submitted,



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